Light and Lighting

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Sports Lighting

IT is probably mere coincidence that, within a few weeks of the award of the Dow Prize to the winners of a competition for the lay-out, artificial lighting and decoration of a sports shop, there should have been a paper on sports lighting read to the I.E.S. The lighting required for displaying and selling sports goods is not, of course, identical with the lighting required for engaging in sports. A good performance in many sports depends a great deal upon the quickness of visual perception, whereas " speed of seeing " is not a critical factor in making a good " buy " of equipment for sports. Abundance of light is necessary for quickness of sight, and everyone knows that bad light stops play in ball and similar games. But a " bad light " is not always bad because the lumens are in short supply : sometimes it is bad because there are too many lumens at the players' eyes which do not come from the things they need to see. Lighting for sports shops and lighting for sports should have at least this in common—that neither is dazzling.

Notes and News

Colour and the Dyer

The thirteenth annual general meeting of the Physical Society's Colour Group was held on March 25 at the Imperial College, for the transaction of formal business and for the election of officers and members of the committee. Dr. L. C. Thomson, director of the Institute of Ophthalmology, was elected chairman in succession to Dr. T. Vickerstaff, while Dr. M. P. Lord, Mr. W. N. Sproson, Dr. J. W. T. Walsh and Mr. R. Donaldson replaced Messrs. H. M. Cartwright, J. A. Chaldecott, B. M. Green and H. G. W. Harding on the committee. Mr. R. W. G. Hunt continues as secretary. In common with other societies, the Group has found it necessary to raise the subscription rates, ordinary members paying 15s. instead of 10s. 6d. and members of participating societies (of which the Illuminating Engineering Society is one) 10s. instead of 5s. per annum.

The annual general meeting was immediately followed by a science meeting at which Dr. Vickerstaff gave his chairman's address on "Colour Problems in the Dyeing Industry." He first explained that a lack of appreciation of the physical aspects of colour and its measurement was very widespread in the industry, and he attributed this partly to the fact that there was a vast body of tradition and craftsmanship and partly to the fact that the colorimeter was inferior to the trained eye in detecting small colour differences.

One problem of great importance, said Dr. Vickerstaff, was to devise a test for the fastness of a dye to washing, exposure to light, etc. He explained that the standard depth of hue used in a fastness test had been evolved quite empirically. The washing test was an imitation of the treatment to which a dyed fabric was subjected in service and the loss of colour (or the transfer of colour to a white fabric) had to be evaluated by comparison with either a hue scale or a grey scale. Surprisingly enough, the latter was found to render visual judgments less subjective. Another problem described by Dr. Vickerstaff was the determination of the effect of background colour on the colour of the bleached areas in a printed pattern. A point of great interest was the effect of the value of illumination by which critical colour matching was carried out. This had been very fully investigated, using as a criterion the performance of experienced colourists. It was found that the performance improved up to about 80 lm./ft.^{2} but above this value there was very little to be gained.

Finally there was the problem of using colorimetry to prepare a recipe for a dye to match a given colour. If the number of ingredients was limited to, say, three

Next I.E.S. Meeting in London

The last meeting of the present session in London will be held at the Royal Society of Arts on Tuesday, May 12, at 6 p.m. Following the formal business of the annual general meeting an address will be given by Mr. D. C. B. Maclurcan, of Sydney, Australia, a past-president of the National Council of the Australian Illuminating Engineering Societies. Mr. Maclurcan is a practising architect and his address will compare lighting practice in Australia with that in Europe.

of completely known characteristics, the problem could be solved but the calculations were very laborious and the experienced dyer could frequently do the job as well and much more quickly. In Dr. Vickerstaff's opinion it was useless to attempt to predict the recipe with a high degree of accuracy; a far better plan was to use the colorimetric method to obtain a first approximation which the colourist could then work on and perfect.

The Younger Generation

The I.E.S. meeting on March 25, at which five student members presented short papers, was described by one of the speakers in the discussion as an experiment on the part of the Society; one of the authors in his reply said that he had experimented with the Society. Whichever way one looks at it the meeting was a successful experiment.

Everyone at the meeting must have been surprised at the excellent delivery and technical content of the papers given by these four young men and one young lady. The Papers Committee has been looking for new authors for years; it has found five and we hope it will not allow them to disappear from view. The meeting showed that with a little encouragement the younger members of the Society can be persuaded to get on their feet and put forward their views on technical matters—and that when they do so they are worth hearing. It was a pity that more of the senior members of the Society were not present as they would have learned quite a bit about how a paper should be presented.

We would like to congratulate the authors firstly on taking the opportunity offered to them to gain some experience in preparing and presenting a paper, and secondly on the success of their efforts.

Design from Britain

The Smithsonian Institution has arranged a travelling exhibition containing nearly 200 examples of good current British domestic designs, including glass, pottery, furnishings and lighting fittings, to tour the United States during 1953-54. The designs included were selected by the Council of Industrial Design on behalf of the Dollar Exports Council. The first exhibition opened in Washington on March 19. The lighting fittings section includes examples from the ranges of the General Electric Co., Best and Lloyd, H. C. Hiscock, Troughton and Young, George Forrest , Cone Fittings, Merchant Adventurers, Hiscock, Appleby and Co., and Patricia McHardy Light Fittings.

Factory Lighting

The Report of the Chief Inspector of Factories for the year 1951 has just been published (H.M.S.O., 6s. 6d.). Once again it contains a section on lighting in which both natural and artificial lighting in factories is discussed. With regard to artificial lighting the Report states that "there has been steady progress which is, in the main, attributable to the widespread use of fluorescent tubes. The extent of the improvement in the standard of lighting during the last 10 years is perhaps not generally appreciated; it is true to say that a most notable advance has taken place, particularly in the small and medium-sized factories, which would not have been possible without the development of the fluorescent fitting. Typical defects encountered before the war were insufficiency of light on the working plane; uneven distribution of light and patches of dark shadows; and the glare from inadequately screened lamps. These defects, particularly the last, still persist; but not where a fluorescent system has been installed." Just in case the foregoing should give the impression that the very use of fluorescent lamps ensures a perfect lighting installation the Report later on hints that more attention should be paid to preventing glare from fluorescent lamps by the provision of suitable reflectors or louvres.

The chief inspector would appear to be a little undecided on the subject of foot-candles versus lumens per square foot though he shows his preference for the latter by using the term five times as against only once for the former.

An original method of lighting a swimming bath by reflection from a cliff face.

Light and Plant Growth

Previous articles on the effect of artificial lighting on plant growth proved of great interest. In the following, the author reviews work being carried out on this subject both in this country and abroad.

By A. E. CANHAM*
M.Sc.(Eng.)., A.M.I.E.E.

Interest in the effects of light on plant growth dates back to the eighteenth century but it has been only during recent years that research has revealed just how important this factor is; at the same time it has provided definite information on some of these effects. Light is now acknowledged to be one of the major factors controlling plant growth and it is essential for the grower to be able to make the best use of both natural and artificial light to obtain the best results in horticulture to-day. Artificial lighting is being developed as a tool for the commercial grower—one which may well become as important to him as any of the other devices so necessary for successful competition in these days of scientific horticulture. The interest of horticulturists in this subject was shown at the Thirteenth International Horticultural Congress held in London during September, 1952, when seven papers were devoted to different aspects of the problem and each one was extremely well attended.

Light has two main effects on plant growth. The first concerns the actual rate of growth of the plant and this is governed by the quantity and quality of the light in which it is grown. The process by which plant foods are manufactured in the leaves from carbon dioxide and water, in the presence of light energy, is known as photosynthesis, and the rate at which photosynthesis takes place controls the growth rate of the plant.

During the winter days, when natural light intensities are low, the satisfactory cultivation of many plants is very difficult because of the slow rate of photosynthesis. For example, the tomato plant is very difficult to grow satisfactorily during the winter, and prolonged spells of dull weather during the normal propagating period produce pale, drawn plants which are very susceptible to disease. This can now be avoided by the use of suitable artificial lighting equipment to give supplementary light of comparatively high intensities.

The second effect is that of the relative daily duration of light and dark periods, and is known as the photoperiodic effect. This controls the flowering mechanism of the plant. Above a certain threshold value the amount of light received during the light period is not important but the spectral quality does affect the response of the plant.

All plants are not influenced in the same way or to the same degree. They are generally classified in three groups—long-day plants, short-day (or long-night) plants, and day-length-insensitive plants. Typical examples of the first group are the China aster and most summer-flowering annuals. In the second group are chrysanthemums and winter-flowering begonias, while carnations, tomatoes and roses are examples of plants which are generally regarded as insensitive to day-length.

Various workers have suggested explanations of this phenomenon, and the full story is by no means complete even now. It is, however, believed that the flower initiation is controlled by the light and dark periods.

As comparatively low light intensities are

* The author is with The Electrical Research Association.

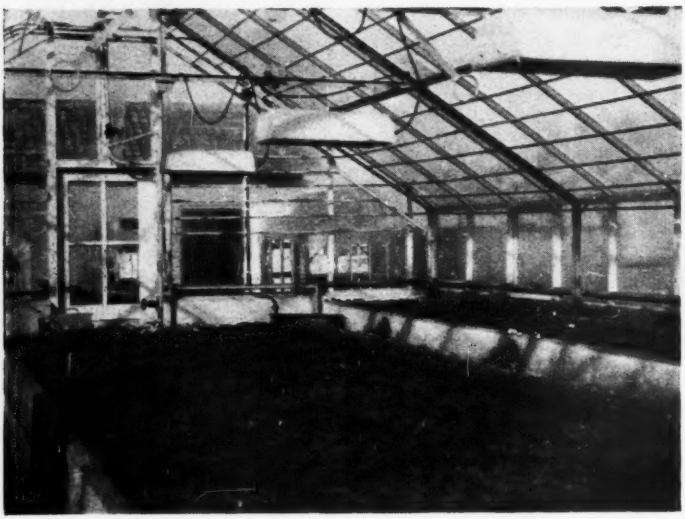
sufficient to produce the photoperiodic effect in plants, and the most satisfactory light source may be the tungsten filament lamp, the equipment required to increase the day-length either for commercial or research purposes could be both simple and inexpensive.

In addition to these two main effects, there is a third which is important in some circumstances. This is known as the formative effect. The habit of the plant is controlled by the spectral composition of the light it receives; predominance of red light tends to produce tall, pale, spindly plants, whilst a sufficiency of blue light is necessary for the development of short-jointed plants of good colour. The formative effect is very closely allied to photoperiodism.

Much information is now available on these various effects, but many problems remain to be solved. Researches tend to fall naturally into one of two classes—the first includes those applications which are likely to be of immediate value to the grower, and the second those primarily concerning the plant physiologist in his quest for basic knowledge of plant behaviour. Both of these are receiving the attention of various research workers in this country and abroad, principally in the United States, the Netherlands, and France.

The phenomenon of photoperiodism was first investigated in America by Garner and Allard in their work on tobacco varieties. It was known that certain varieties of tobacco plant which were grown extensively in parts of the United States failed to produce flowers when grown in other latitudes. During a series of experiments on these plants a number were grown in glasshouses during the winter and were found to flower normally. When the days lengthened during the spring, non-flowering shoots were again produced. Further experiments, in which the day-length was controlled, proved that this was indeed the factor controlling the flowering of this plant. Since then the responses of many kinds of plant to different lengths of day and night have been investigated, and to-day in America this work is being continued at the Bureau of Plant Industry, Soils and Agricultural Engineering. Their results with sugar-beet and strawberries were given by Dr. Borthwick and Dr. Parker at the International Horticultural Congress.

The role of light as one of the many controlling environmental factors is being studied by Professor F. W. Went at the Earhart Plant Research Laboratory of the California Institute of Technology, Pasadena. This laboratory has been specially built and equipped for this and other purposes, and is known almost universally as the "Phytotron." In addition to a large number of glasshouse sections which are, to a large degree, air conditioned to give a



Mercury lamps for irradiating tomato plants at the Institute for Horticultural Engineering, Wageningen.

An experiment on the effects of low - light intensities on cinerarias at Utrecht.

wide range of atmospheric conditions, it is also equipped with temperature-controlled chambers illuminated entirely with artificial light of different spectral composition.

Plants are grown, in nutrient solutions, on small-wheeled trolleys which can be moved about the laboratory from one glasshouse or controlled room to another to give any required succession of treatments. As a result of his work in this laboratory—the most elaborate of its kind in the world—Went is collecting a considerable amount of data on the effect of light and other environmental factors on plant growth.

On a smaller scale Went's methods have been adopted in this country by the Reading University Horticultural Department at Shinfield Grange, where Professor R. H. Stoughton and his staff are primarily interested in the problems of plant response to artificial light. They have built nine dark chambers, in which almost any light condition can be applied to plants wheeled in on trolleys from adjacent glasshouse sections, or grown permanently in the chambers. Four of these have been fitted with fluorescent tubes, on a framework, to give at the plant positions the same energy level of red, blue, green and white light respectively, and the responses of various plants are being studied under these conditions.

Much work on the effect of day-length on the flowering of chrysanthemums is being done at Shinfield. The chrysanthemum is a "long-night" plant, and will flower only when the nights have lengthened to about 14 hours. By lengthening the day artificially the flowering can be delayed more or less as required—almost indefinitely if necessary. This fact has applications in commercial horticulture in delaying blooms to catch special markets, particularly at Christmas time.

It has already been proved that satisfactory treatment can be given using 40-watt tungsten filament lamps suspended 4 ft. apart above the plants, either extending the day to 14 hours or breaking the night by giving two hours' treatment in the middle. Aspects of the problem which are now being investigated include the dates at which treatment should be given and the response of different varieties.

Other subjects under investigation at Reading University are the strawberry (with particular reference to the influence of day-length, light intensity and temperature on flower initiation and runner production), the carnation, annual flowers and some vegetables.

Further work on photoperiodism is being carried out by the Institute of Plant Physiology at the Imperial College and Rothamsted Experimental Station. Here Dr. Schwabe is also investigating the effects of day-length and temperature in the control of flowering in the chrysanthemum, and his

work is primarily intended to provide fundamental information about the complex processes which encourage or inhibit flower initiation.

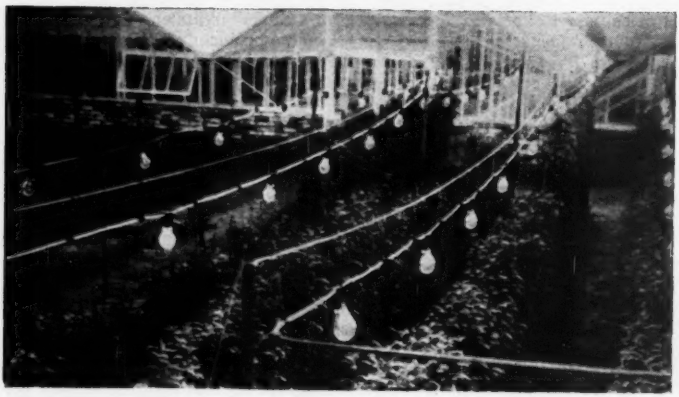
The application of artificial lighting which is at present of most value to the commercial grower is that in which winter daylight is supplemented to improve the growth of tomatoes and cucumbers. Work on this aspect is being carried out both by the Electrical Research Association (E.R.A.) at their Field Station at Shinfield, near Reading, and by the John Innes Horticultural Institution at Bayfordbury, near Hertford. The work of Lawrence and Calvert at Bayfordbury was described in an earlier issue of this journal.* Work has continued during the past season, and this has included tests on the use of both neon floodlighting tubes and mercury vapour lamps.

The spectral distribution of the neon lamp is much more suitable for plant growth than that of the mercury lamp, but the cost of the control gear and the lack of a suitable reflector fitting discourages its use in practice at the moment. The lamp which is now being used in increasing numbers is a 400-watt type MA/H lamp fitted in a special trough reflector, and this gives very good results. These are mounted 3 ft. above the bench and 4 ft. apart; under these conditions each lamp will satisfactorily illuminate an area 3 ft. 6 ins. wide and 4 ft. long. They may be used to treat either one or two batches a day. If only one batch is treated, the lamps are switched on shortly before sunset and off again when the plants have had a maximum of 18 hours of light—daylight plus artificial. This period is not so critical for cucumbers and possibly some other plants, but with tomatoes it is essential that they have a period of at least six hours of unbroken darkness, otherwise abnormal development occurs. To make the maximum use of the equipment it is possible to treat two batches a day by moving the lamps on rails from one to the other. If this is done each batch should be illuminated for 12 hours, partly during the day and partly during the night. Ideally, midnight and noon are the best times for the changeover, but in practice 10 p.m. and 10 a.m. are more convenient and are quite satisfactory in December. Normal treatment of tomato and cucumber seedlings starts at the pricking-out stage and continues for three weeks. By this time the plants have grown to such a size that they need spacing out and further illumination would be much less economic.

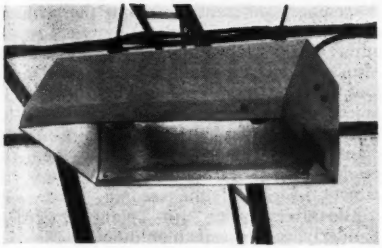
Such treatment produces much more rapid and satisfactory growth, with the result that propagating time is reduced by about a fortnight, and the plants produced are sturdier and healthier than those grown in the usual way. This means that the grower can either sow his plants at the same time as usual and get earlier cropping, or sow a fortnight later and have his plants ready at the usual time with the saving of a fortnight's fuel. Either way it is a sound economic proposition.

One of the difficulties encountered in research using lamps with widely differing spectral characteristics is in the measurement of the amount of light received by the plant. While it has been proved that the

* "Recent Developments in Plant Irradiation," by A. Calvert. *Light and Lighting*, Vol. XLV, No. 2, p. 51 (1952).



An installation of 40-watt filament lamps for extending the length of day for chrysanthemums at Reading University Horticultural Station.



G.E.C. 400-watt mercury lamp and fitting designed for horticultural use.

increase in plant growth is directly proportional to the amount of additional light it receives in "foot-candle-hours," this is only true for light of a given quality. Equal intensities in foot-candles of neon and mercury light have a widely differing effect on plant growth.

The importance of this was appreciated at the International Horticultural Congress when a resolution was passed recommending the establishment of an international unit of light energy which could be used for all light sources. A lead has already been given by the Netherlands, in that they have already decided to adopt a unit which they have called the "sol," and which is equivalent to 1 milliwatt of visible energy per square metre. They have also divided the spectral range into a number of bands to enable different light sources to be compared for plant illumination purposes on a basis of the percentage of the visible energy which is present in each band.

If complete information on the response of plants to light energy of various wavelengths were available, the curve of plant response plotted against wave-length could be combined with the spectral distribution curves for the various lamps and the known response of the photocell. This would give a factor for each lamp by which light intensity, as measured in foot-candles by that particular photocell, could be converted into energy units, which would provide a definite indication of the value of such light to the plant. One such plant response curve was published in 1937 by Hoover, and this was reproduced in an earlier article in this journal.* This curve was obtained as a result of work on wheat, and it remains to be proved whether it is also applicable to other plants.

This need for a standard unit of energy for the comparison of the effect of various light sources has been shown in the work of the E.R.A. on photosynthesis. In these experiments light sources ranging from tungsten filament, sodium vapour, neon and other lamps of various sizes to a 2½ kw. mercury vapour lamp have been tested from the point of view of plant response, light distribution and economy. In each case the tomato plant has been used and increases in growth compared by the dry weights of the plants. A limited number of plants have also been grown on to fruiting.

Another investigation which is being carried out by the E.R.A. and which is also of immediate practical interest to the grower concerns the use of tungsten filament lamps for extending the daylength for strawberries grown in frames. This treatment hastens flowering, and is being combined in this instance with soil warming for the production of early strawberries. Actual results are not yet available, but reports of similar tests on strawberries under cloches have been encouraging.

In the Netherlands a considerable amount of research work has been carried out and is still in progress at many research centres of the Ministry of Agriculture, at the Agricultural University of Wageningen, and in

* "Lighting in Relation to Plant Growth," by K. J. Mitchell, *Light and Lighting*, Vol. XLIII, No. 9. p. 345 (1950).

The effect of supplementary artificial light on tomato seedlings. Experiment at the John Innes Horticultural Institute.

the laboratories of commercial lamp manufacturers. The Dutch Ministry of Agriculture has a separate laboratory for this work known as the "Laboratory for Light Research in Horticulture." This is at Utrecht, and the work is directed by Dr. J. W. M. Roodenburg, who has been working on the effects of light on plants for many years.

Experiments in progress at Utrecht in the spring of 1952 included investigations of the effect of additional lighting given during the day and during the night on lettuces, and a study of the photoperiodic effect of low light intensities on asparagus fern, *saxifraga pyramidalis*, cineraria and gloxinia. Other subjects of earlier experiments have included tulips, chrysanthemums, iris and cytisus, while much work has been carried out in the past on tomatoes—using supplementary light and also using artificial light entirely—cucumbers, gloxinias, and many other subjects.

Experiments on the use of additional lighting for tomatoes and cucumbers have also been carried out at a growers' research station at Naaldwijk using various kinds of light source. This technique is now being used commercially by a number of growers in the Westland glasshouse area, and here again the lamp which has been found to be the most economic for the purpose is the mercury vapour lamp, the standard size being 450 watts. These are mounted somewhat higher and each lamp covers a larger area of bench than is now recommended in this country and, to compensate for the lower light intensities, the period of illumination is extended to about five weeks. This has the advantage of a cheaper installation, but on the other hand the rate of growth is much reduced.

One application of artificial light which is very popular in the flower-growing areas in the neighbourhood of Aalsmeer concerns the culture of begonias. The use of comparatively low light intensities to extend the length of day during winter prevents the plants going dormant; as a result the plants start growing very much earlier, and it is possible to take cuttings for rooting during January instead of May. This means that the resulting plants are much earlier and therefore much larger and healthier when marketed. Incandescent, mercury and neon lamps are all used for the purpose; one particular holding has over three-quarters of an acre of glass entirely devoted to begonias, and each glasshouse has neon lamps fitted in the apex.

At the various research stations at Wageningen different aspects of the problem are studied, from the purely practical to the purely plant physiological. In many cases also, artificial lighting is being used as a tool, and is quite incidental to the main object of the research. For instance, by increasing the day-length of certain biennial plants it is possible to cause them to produce seed during their first year of growth instead of the second. This is of considerable value in plant breeding. Similarly, additional high-intensity light is very often employed to increase the growth rate of some otherwise slow-growing plants.

The response of the strawberry has been very closely studied at Wageningen and, as a result, a table has been published giving the precise external conditions of temperature, day-length, additional light, etc., required to produce strawberries at any time of the year. Many of the processes are, however, unlikely to be sufficiently economic for commercial application. Other interesting investigations have included the use of low light intensities to prevent potato tubers from sprouting in storage and to induce colouring in apples and the continuous illumination of a single petunia plant which resulted in continuous flowering throughout the year.

Finally, mention must be made of one other subject of research which has received rather more attention in the Netherlands than in this country, although one or two pilot installations have been made here and in France. This involves the use of comparatively low intensities of incandescent light by means of which bulb flowers such as tulips, daffodils and irises can be grown in otherwise completely dark buildings. The significance of this is twofold. Primarily it means that such flowers can be forced in buildings with walls made of heat-insulating material instead of glass, which naturally results in a considerable saving of heat, but it also means that the flowers can be grown in tiers instead of in single layers, with a further considerable saving of heat. When tier growing is adopted the lamps are fitted to the underside of the tier above and the use of two or three tiers is quite practicable. It can be shown that by using three tiers in a very well insulated building, the heat required for forcing a given number of bulbs is theoretically less than 10 per cent. of that which would be needed in a glasshouse.

The function of the light in this instance is to produce colour in the leaves and flowers; high intensities are not required as the food needed for growth is stored in the bulb and its manufacture in the leaves is not

important. Forty-watt lamps uniformly distributed to give about 85 watts per square yard of bench area and mounted about 30 in. above the bulbs are quite satisfactory for tulips and daffodils, but for irises they should be arranged to provide at least 130 watts per square yard. In both cases illumination should be given for 12 hours each day. Aspects of the problem which have been studied in the Netherlands have included the effect of different light intensities, duration of illumination and air temperatures on daffodils, irises and many different varieties of tulip, while in France one grower has used this technique in a glasshouse, reducing his heat losses by covering the glasshouse with a thick layer of straw.

It has not been possible in an article of this kind to attempt more than an outline of the considerable amount of research which is being undertaken on the various ways in which artificial lighting can be applied to plant growth. The possible variations in light intensity, day-length, spectral distribution and light source are themselves legion, and when, as in plant growth, the ambient temperature, supply of moisture and carbon dioxide and other conditions combine with the variations in light, the problem becomes immense. Add to this not only the multiplicity of plant species which vary in response, but also the different varieties within each species which again may respond differently, and it is not surprising that research, which started over a century ago and is at present being carried out on an appreciable scale throughout the world, shows every sign of continuing indefinitely as each worker tackles one or two facets of this fascinating subject.

Lighting Fittings Competition

The winning entry in the electric light fittings section of the Industrial Art Bursaries Competition, 1952, organised by the Royal Society of Arts, was submitted by Mr. Leonard Summers, of the Birmingham College of Arts and Crafts, who receives the bursary of £150. Four other entries were commended.

The primary purpose of the competition is to help successful candidates to broaden their knowledge and experience by travel abroad and the study of foreign design, or, in certain cases, to obtain art training or industrial experience in this country.

An exhibition of winning and commended designs will be held at the Royal Society of Arts, John Adam Street, London, W.C.2, between May 11 and 22. Reports submitted by previous bursary winners on their tours abroad will also be on view at this exhibition. Details of the 1953 competition are now available from the Royal Society of Arts.

Simplified Glare Rating Tables

In a recent number of the Bulletin of the Association Suisse des Electriciens (Vol. 44, No. 6, Mar. 21, 1953) there is an interesting article on glare ratings by R. Spieser and W. Mathis, based on the work of Harrison and Meaker in the United States. The authors have taken seven lighting fittings as typical of modern European practice. One is the simple opal sphere, the others are fittings commonly used with fluorescent lamps, and in each case two or more tables are provided. The first is the main table giving glare ratings for a range of room dimensions and mounting heights. In the case of the fluorescent units different values are given according as the principal direction of viewing in the room is along or perpendicular to the lengths of the fittings.

The first subsidiary table gives a correction factor depending on the value of illumination provided in the room. For certain fittings a second subsidiary table gives another correction factor depending on the reflection factors of the walls and ceiling, while in cases where the bare lamp is visible a third correction factor, proportional to the luminance of the lamp, is applied.

The final glare rating is the continued product of the figure obtained from the first table and the appropriate correction factor or factors obtained from the subsidiary tables.

The method is certainly very simple to use in practice, and this is well brought out in a worked example at the end of the paper. Acceptable glare ratings for different classes of interiors are given.

Personal

MR. H. G. CAMPBELL, Joint Managing Director of Benjamin Electric, Ltd., sailed on the *Queen Elizabeth* on April 1 to visit the United States and Canada where he will study lighting practice. He is due back in this country on May 25.

MR. ALAN H. OWEN, of Manchester, recently attended the 10th Canadian Regional Conference of the American I.E.S. in Ottawa and presented a paper by himself and Mr. J. S. Smyth on "Black-out Lighting in War-time."

MR. CECIL HUGHES, of Siemens Electric Lamps and Supplies, Ltd., has succeeded Mr. Scott Adie, of Rowlands Electrical Accessories, Ltd., as President of the Electric Light Fittings Association.

Seeing with Foglamps

Experiments show that at night in dense fog increase in the intensity of a foglamp beam beyond a certain low limit has little effect, and that the available light would be better used to illuminate the full width of the road near the vehicle. Yellow beams have no advantages over white beams of similar intensity and shape.

By V. J. JEHU,* M.Sc., A.Inst.P.

Any motorist who has used headlamps at night in thick fog will know how well both the driving beam and the meeting beam appear to illuminate the fog, and how poorly they indicate the way ahead. In an attempt to direct more light at the road surface and less at the fog, many types of foglamp have been designed and marketed in this country. Generally these lamps can be divided into two classes, lamps which produce a narrow intense beam of light and lamps which produce a horizontal fan-shaped beam. The narrow-beam lamps usually have peak intensities of at least 30,000 candelas, while the maxima of the fan-beam lamps are generally in the region of 10,000 candelas. The difference in intensity is not deliberate, but follows from the fact that the output of the lamp is limited and that if the light is spread more widely its peak intensity must generally be reduced. Both types of lamp are usually mounted low and the beams aimed some distance ahead to illuminate the near-side kerb. In the thickest fog, however, neither type of foglamp appears to be good enough to enable traffic to keep moving. This article describes some investigations into the visibility afforded by different types of foglamp beam, and draws conclusions as to the design and mounting arrangements which seem likely to be most efficient.

Measurements of the Seeing Distance in Fog

Experiments have been carried out at the Road Research Laboratory to find out how the seeing distance in fog at night depends on the mounting height of the foglamp, and on the shape, the cut-off, and the intensity of the beam.

Three lamps giving beams of different shapes were mounted on a horizontal bar across the front of a vehicle which was driven slowly forward in a fairly thick fog until the outline of a small target placed at the same height as the lamps could be distinguished against the background of illuminated fog. Seeing distances were obtained in this way for each of the three types of beam, for beam intensities ranging from 1,000 to 8,000 candelas and for lamp mounting heights of 16 in. and 48 in. The three beam shapes were:—

(1) A narrow semi-circular beam with a very sharp horizontal cut-off.

(2) A wide fan-shaped beam obtained from a commercial foglamp, for which the cut-off was much less sharp than for (1).

(3) A square-shaped beam of uniform intensity, aimed so that even at 4 deg. above the horizontal the intensity was still as high as that aimed at the target.

It was found that in the conditions of the test the mounting height made only a small difference in the seeing distance. The results obtained when both lamps and target were mounted with their centres 16 in. above the ground are shown in Fig. 1, where the distances at which the target was recognised are plotted against beam intensity aimed at the target. A similar set of curves was obtained when both lamps and target were mounted with their centres 42 in. above the ground, except that the absolute values of seeing distance obtained with the high mounting were about 10 per cent. less. It is probable that a greater improvement in seeing would have been obtained with the low-mounted lamps if the target had been on the ground for both the high and low mountings, or if the aim of the lamps had been varied at the same time as their height. The question of mounting height will be returned to later in connection

* Road Research Laboratory, Department of Scientific and Industrial Research.

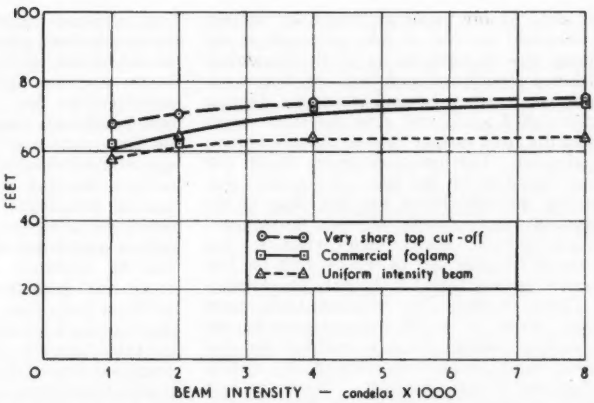


Fig. 1. Seeing distances in fog with low-mounted foglamps having different types of beam.

with tests of lamps under actual driving conditions.

Fig. 1 shows that the beam with the very sharp top cut-off did not permit appreciably greater seeing distances than the beam from the commercial foglamp, whilst both these beams gave seeing distances which were about 10 per cent. greater than those obtained with the uniform-intensity beam, in which the cut-off was so poor.

Thus although it is desirable to use a sharp cut-off to eliminate as far as possible the stray light which simply illuminates the fog, yet little is to be gained by complete elimination of the stray light. The surrounding fog is illuminated by light scattered out of beam by the fog particles themselves and in thick fogs this light may be more important than the stray light from the lamp. It will be particularly important in thick fogs, however, to avoid stray light which emerges from the lamp at large angles to the direction of the beam, so that a cap over the filament or similar device is desirable.

The outstanding feature of Fig. 1, however, is the fact that the seeing distance increased only by about 10 per cent. while the intensity was raised from 1,000 to 8,000 cd. The fact that the seeing distance is not increased indefinitely by increasing the intensity of the beam is suggested by experience with searchlights, and is to be expected from theoretical considerations of the scattering of light in fogs.(1) (2) Since the improvement in seeing obtained with increasing beam intensity is small above a comparatively low beam intensity, it appears that the light available from a foglamp, which has normally been used in this country to produce a high-intensity beam, could be used to better advantage to produce a beam with a lower intensity and a wider spread. There would be only a small decrease in the seeing distance and this would be compensated by a very large increase in the width of the region revealed. A test of such a beam was therefore made under practical conditions.

Observations on the Road

A lamp was constructed which gave a fan-shaped beam with a horizontal spread of about 60 deg., this being about twice the spread of the widest British fog beam (Fig. 2a and 2b). The top cut-off of the beam was comparable with that obtained with the commercial foglamp, but the maximum intensity of the beam was about 4,000 instead of 9,000 cd. The two beams shown in Fig. 2 were then compared on the road, both lamps being mounted with their centres 18 in. above the ground.

During one test in a dense fog it was found that the limit of forward visibility of the kerb and road surface with either lamp was about 25 ft., when the beams were aimed so as to give maximum range of visibility. Under these conditions the driver could position the car on the road with more confidence when using the wide beam, since both the near and offside road verges of a road 30 ft. wide were seen in the beam in spite of the fact that the beam was well dipped. At road junctions there was always some visible indication of the direction of the road when the wide beam was used; this was not the case with the narrow beam, particularly at junctions in which a gap occurred in the nearside kerb.

The best setting of the lamp was found by varying both the height and the angle

of dip. At any mounting height the distance one could see was at first increased as the lamp was brought nearer to the horizontal from a strongly dipped position, but a setting was reached beyond which the distance diminished again and even the road verges and the road surface near to the car became indistinct. The lowest mounting height was not found to be the best. When the lamp giving the wide beam was just clear of the ground and aimed almost horizontally visibility was worse than when it was mounted higher up. In thinner fogs the low mounting was found to be very satisfactory.

Thus in dense fog the wide-angle beam was found to be an improvement on the narrower beams, since it enabled the full road width to be seen without any noticeable loss in seeing distance. Since the tests described were carried out French foglamps having a beam as wide as that given by the experimental lamp have become available in this country. A wide beam can also be produced with a pair of British foglamps mounted one on either side of the vehicle; this method is being used on some cars at the present time.

The Foglamp Mounting

It has been shown that low mounting of a foglamp and some degree of sharpness of top cut-off to the beam improve seeing in fog, probably because both lead to a reduction in back glare along the line of sight of the driver, but that the best mounting height and aim depend somewhat on the density of the fog. In mist or thin fog the best results are obtained by mounting the foglamp very low and aiming the beam almost horizontally to illuminate the road surface; the fog is then barely noticeable against the bright road surface. As the density of the fog increases, however, more light is scattered in the direction of the driver and the brightness of the fog increases in comparison with that of the road. In order to direct more light at the road and less at the fog, the foglamp must be raised and at the same time the aim of the beam must be depressed below the horizontal. Ideally the foglamp mounting should be such that both the height of the lamp and the aim of the beam are easily adjustable.

The height at which the lamp should be mounted to deal with thick fogs will be a compromise between having the beam sufficiently low so that the driver does not look along the beam, and sufficiently high so that the maximum forward seeing distance can be obtained when the beam is appreciably dipped below the horizontal plane. These two conflicting requirements limit the mounting height which will give the best results

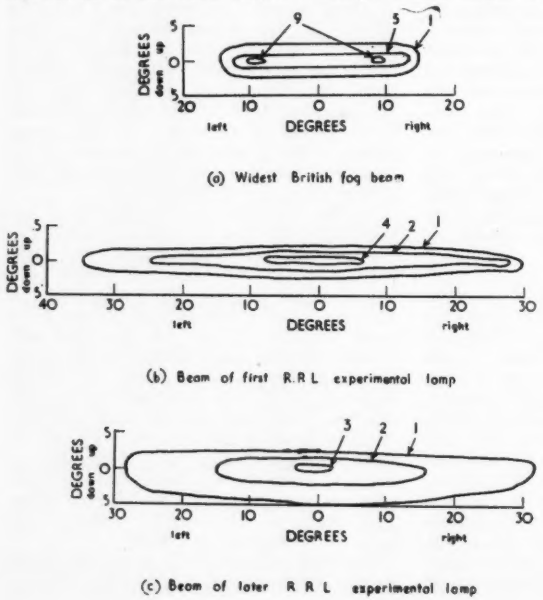


Fig. 2. Beam distributions of foglamps. Figures to curves denote candelas in thousands.

in thick fog to about 2 ft. from the centre of the lamp to the ground for cars, and probably somewhat higher for commercial vehicles.

In practice the provision of an adjustment for the height of the foglamp might present difficulties; it can be dispensed with if the very low mounting which is the best arrangement for use in thin fogs is sacrificed, and the lamp is mounted with its centre at about 2 ft. above the road. The mounting should be such that the aim of the beam is easily adjustable.

Position of Foglamp

In thick fog the car driver's view of the road ahead is restricted to the road surface which is visible beyond the bonnet and the offside wing. Fig. 3 shows in plan for a typical car the region of the road surface which can be seen from the driver's seat. The shape of the boundary varies little between different common makes of car and between pre-war and post-war cars. A driver of average height seated normally cannot see the nearside kerb closer than about 30 ft. from the driving seat; over the offside wing of the car the road can be seen nearer than 20 ft. The design of most modern commercial and public service vehicles allows the road to be seen from the driver's seat at much shorter distances than is possible in cars.

It is evident from Fig. 3 that the driver with the narrow beam who relies on the nearside kerb would be able to keep on the move in thicker fogs by mounting the foglamp on the offside of the car and aiming the beam at the road visible beyond the offside wing of the car, where it will illuminate lane markings along the road if these are present. The lamp giving the wide-angle beam should also be mounted on the offside of the car, and the plane containing the maximum intensity aimed at a line across the road about 30 ft. in front of the driver. When the density of the fog is such that the nearside kerb can no longer be seen the driver will still be able to see the lane markings along the road, particularly if the beam pattern is not shallow. For the best results, the beam distribution of the lamp should be asymmetric in a vertical plane, with the maximum intensity nearer the top of the beam than the bottom. Fig. 2(c) shows such a beam distribution which was obtained from a later experimental lamp.

Reflecting Road Studs

Since they can be seen closer to the car than the road verges, lane markings along

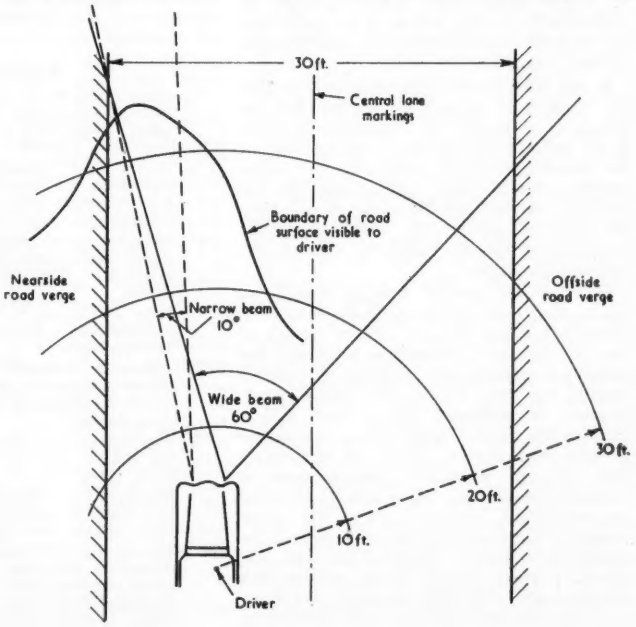


Fig. 3. Wide and narrow beams in relation to kerbs, lane markings, and region of road surface visible to car driver.

the road are of more use to the driver in thick fog. Where the markings include reflecting road studs the driver's effective seeing distance will be increased. Reflecting road studs have the property that the light incident upon them is directed back within a few degrees of its original path. Full use cannot be made of this property in fog because it would mean mounting the foglamp as close as possible to the driver's line of sight, an arrangement which has been shown to be undesirable in fog; but a great deal of help can still be obtained from the studs by the use of the foglamp mounted on the offside of the car, a position which is more effective than the nearside because it brings the light source nearer to the axis of the stud. The studs can be seen in the beam of the lamp at distances beyond those at which the road surface is visible. For this reason the inclusion of reflecting road studs in all lane markings would be an aid to driving in fog, provided that foglamps were mounted and aimed to make use of the studs.

Colour of the Light

The tests described so far were carried out with white light. It is frequently argued, however, that yellow light penetrates fog better than white light, and many motorists fit yellow filters over their foglamps, or yellow bulbs in their lamps, in the belief that by so doing they improve the performance of their foglamps.

It has been shown theoretically(3)(4) that the important factor in determining the scatter of radiation by suspended particles is the ratio of the radius of the particles to the wavelength of the radiation. For wavelengths greater than the radius of the particles, the smaller the value of this ratio the less the scatter and hence the better transmission of the radiation through the suspended particles.

Work on the particle sizes of fogs(5) has shown that most of the droplets have radii between 1 μ and 10 μ (1 μ is 10^{-3} mm.), so that no increase in transmission through fog would be expected for radiation with wavelengths less than 10 μ. The visible wavelengths lie between 0.4 μ and 0.75 μ wavelengths greater than 0.75 μ correspond to infra-red radiation. It will be seen, therefore, that no noticeable improvement in transmission through fog would be expected on theoretical grounds unless the wavelength of the radiation was well beyond the visible wavelengths. Experimental work has generally given results which confirm this conclusion(6), although improved transmission has sometimes been recorded with wavelengths in the region of 1 μ(7). On these occasions it is likely that the fog particles were smaller than usual, since the size of the droplets varies with the type, age, and density of the fog.

Any improvement in seeing which can be attributed to the use of yellow light would thus appear to be due to a differing response of the human eye to light of different colours rather than to an increased transmission of the light through the fog. No evidence of any such improvement has been obtained. Observations in fog have been made at the laboratory with a yellow beam and a white beam identical as to intensity and shape of beam. No difference was noticeable either in ordinary driving or in static observations of the seeing distances of objects illuminated directly by the two beams. This is in general agreement with the results obtained in other countries(8). There seems little likelihood, therefore, that vision is directly or substantially improved by the use of yellow light.

Acknowledgments

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The French Approach to Visual Comfort

By JEAN MAISONNEUVE

Although as yet little research has been carried out in France on this subject, considerable interest is shown in the problems relating to visual comfort by French lighting engineers, whose reactions and opinions are described in this article.

Up to the present we have not had the satisfaction of seeing any work undertaken in France on the subject of visual comfort comparable with that which has been carried out at the Building Research Station in England and by other research organisations in America and Holland. We hope that one day our country will be able to make a contribution to this work, which is of great importance in good lighting.

Although there has been no research work in our own country, French lighting engineers take an active interest in the results published by other groups of workers who have tackled the problem. The fact that these reports from various countries have basically similar results enables the French lighting engineers to discuss the matter at their meetings. The Société Française des Eléctriciens, for example, have devoted many of their discussions to this subject. We in France urgently need a sound basis which could be developed into a technique of "brightness engineering" for universal adoption.

In the lighting world one often hears it said that the problem of visual comfort is extremely difficult to solve and that no indisputable solution has yet been put forward. However, one can distinguish the different approaches in various published studies and in the resulting recommendations concerning the required brightnesses in places of work.

Some consider that the whole idea of visual comfort is far too subjective, varying in consequence from one person to another, for a sufficiently general characteristic to be attributed to the conditions conducive to visual comfort which can only be determined experimentally.

The generalisation of experimental results would be impossible; all hope would have to be abandoned of ever introducing the idea of visual comfort other than in the form of fairly vague recommendations, and no guidance would be given by the published figures.

Others appear far less sceptical with regard to the possibility of producing a brightness technique laying down conditions of visual comfort in a form for direct use by practising lighting engineers. They appreciate the value of the work carried out in other countries, and they have studied the published papers on the subject. At the same time they ask a number of questions, such as:—

Do not the experimental arrangements adopted place the subjects of the experiments under conditions which are far too artificial, i.e., different from those which are found in a factory, office or any other place of work?

As the number of subjects is necessarily limited, are the results obtained of real statistical value?

This attitude represents the feelings of most French lighting engineers who have studied the subject. They feel, in keeping with the advice given by the authors of the work in question, that there is justification for treating the results already published with some caution. But they are, nevertheless, convinced that lessons can be drawn, and some of them have already done so in an original contribution (see Cadiergues, "Lux," Nos. 1, 2, and 3, 1952).

At the same time it is worth noting the

observations, which may be taken as general, made by those in France who, although not lighting engineers, are in a position to form an opinion on visual comfort in practice. In this way we obtained the opinion of a medical officer in charge of the medical section of a large factory. In his opinion the fluorescent lighting installation in this factory—designed in accordance with good modern practice—gave to both works and offices too uniform an appearance which eventually caused a feeling of lassitude amongst the workers. According to him, it would appear necessary for the worker to always have the impression that his place of work is clearly better lit than the rest of the area.

This doctor bases his opinion on a prolonged study of the fatigue reaction of factory personnel and his opinion certainly deserves some consideration. If it were found to be true it obviously sets a problem in the lighting of factories and offices by fluorescent lamps. Fluorescent lighting is essentially a diffused light so that the differences of illumination are, in most installations, hardly noticeable. Therefore, if it is really necessary to pick out working areas by having an obviously higher level of illumination than other parts of the area, it would become necessary either to do away with general lighting, or always to install supplementary lighting, or to adopt fairly deep colours for the walls, ceiling, and floor so that the relative brightness of work benches and machines could be increased.

I would hasten to say that lighting engineers in France do not accept this latter as the solution to the problem. On the contrary, they continue to recommend the use of light colours which are used more and more in offices and factories. We only regret that so few organisations in our country are in the habit of redecorating at sufficiently frequent intervals.

In accordance with usual practice, which up to now has seemed reasonable, French engineers, like their overseas colleagues, advise on the choice of suitable reflection factors but not as a rule on the choice of colours.

During the last few years various opinions have been expressed in different countries on the possibility of rationalising the selection of colours for places of work. In 1950 there was set up in France a "Centre d'Information de la Couleur," the objects of which are similar to the Inter Society Color Council of the United States and the British Colour Council.

Among other activities the Centre d'Information de la Couleur has undertaken the task of investigating the colours which are most suitable for walls, benches, tables, etc., in order to create the most favourable atmosphere. Their studies are concerned equally with colour contrast and brightness contrast. It is obvious that these questions are clearly tied up with the problem of lighting from the point of view of visual comfort, and that lighting engineers are likely to participate more and more in the work of the Centre d'Information de la Couleur.

It would, of course, be ideal except in very special cases, to be able to prescribe definite colours for different kinds of workplaces, but in any case such prescriptions would not be in the province of the lighting engineer. None the less, it is important that the colour of the walls, etc., must be chosen bearing in mind the colour of the lighting. However, this choice will work methodically only after a systematic study of colour rendering of paints and wallpaper under incandescent and fluorescent light—a study which, in France, has as yet scarcely been touched upon. We hope that it will shortly be undertaken, thanks to the collaboration of paint manufacturers and lighting engineers, particularly those who have made a special study of colorimetry. This work will help to bring more method to the choice of colours and, in consequence, to the achievement of surroundings acceptable to the eyes.

To conclude this brief review, I would mention the attitude taken by the Association Française des Eclairagistes, who last year published their "Récommendations rélatives à l'Eclairage des bâtiments et de leurs annexes." As was mentioned in *Light and Lighting* (January, 1953), these recommendations are very similar to the 1949 edition of the I.E.S. Code. However, in the chapter devoted to the elimination of causes of glare, we have not hesitated to make use of the latest information from the Building Research Station and from the United States. It has been noted that the results obtained from such sources are neither sufficiently definite nor sufficiently general to be made the subject of a code of practice. "It is, however, indispensable," says the A.F.E., "for the lighting engineer to take into account a certain number of facts which seem well established."

These few lines, we believe, sum up the present opinion of French lighting engineers on the subject of visual comfort.

The Physical Society Exhibition

The following is a brief description of the thirty-seventh exhibition of the Physical Society which was held in London from April 13-17.

Although this, the thirty-seventh exhibition of physical instruments and apparatus, seemed to be at least as large as ever, the number of exhibits which were of direct interest to the lighting technologist was quite small. One reason for this was that the Colour Group, who on the last few occasions staged some exceedingly interesting series of exhibits and demonstrations, were not this year exhibiting as a Group.

Photometers

There were, as usual, a few illumination photometers of the photo-electric type, notably the cosine-corrected instrument of high sensitivity made by Megatron, Ltd. It is now possible to obtain a photometer of this type which will give full-scale deflection for an illumination of 0.1 lm./ft.^{2}, although this naturally means the use of a very sensitive galvanometer. Megatron were also showing a number of special selenium cells with high sensitivity in the infra-red and a cell with a sensitivity curve similar to that of panchromatic photographic material and therefore specially suitable for photographic exposure meters.

Flame photometers, which were noticed last year as an important addition to the equipment of the biologist, were being shown by a number of firms, including Evans Electroselenium, Ltd. Evidently these instruments have now established themselves in an interesting application of photometry to the measurement of minute quantities of important elements in a solution.

Evans Electroselenium were also showing a photometer bench with an effective length of 1 metre, designed primarily for educational purposes, such as the demonstration of the inverse square and cosine laws. A sub-standard lamp and a photocell were mounted on carriages movable along the bench, and both could be rotated over graduated scales.

The Baldwin Instrument Company, Ltd., showed their photo-electric reflection and transmission densitometers and a photo-electric absorptiometer.

Colour Measurement

The Tintometer Colour Laboratory were showing the prototype of an entirely new pattern of the Lovibond Tintometer. This had a number of improvements, notably :—

(a) A larger aperture, the mean angle being increased from 2 deg. to 4 deg. so as to make the measurement of very light colours somewhat easier.

(b) An adjustable eyepiece, providing a variation of angle from 90 deg. (vertical) to 50 deg. when using the instrument in its normal horizontal position, while for vertical working the eyepiece could be tilted downwards from horizontal to 10 deg. depression. This allows the operator to be seated in comfort.

(c) The light sources were placed in the centres of 4½-inch-diameter integrating spheres with diffusing windows at the sides. In this way the illumination of the sample was considerably increased, with a consequent extension of the range of the instrument as regards the measurement of very dark colours.

(d) The obturating system was of a new design, with a fixed diaphragm at the zero point effectively separating the sample and matching fields, so that variations of intensity in one field did not affect the intensity of the other field.

In this new instrument variations of intensity of the sample and matching fields

are produced by means of metal slides which reduce the light source apertures in discrete stages. The range from 0 to 1 in visual density in each field is provided by sliding vanes. Extension to density 2 is produced by slides which close the aperture to correspond to density 1, and then the vanes are traversed over the source thus reduced. To cope with the measurement of blacks, the matching field is provided with a further stage of density from 2 to 3.

Apparatus for the direct measurement of colour temperature was shown by Megatron, Ltd.

Spectrophotometers

A new design of photo-electric spectrophotometer was shown by Unicam Instruments (Cambridge), Ltd. The optical element was a simple Littrow monochromator with a glass prism and the receiver a vacuum photocell with amplifier and calibrated potentiometer. Two photocells were provided, with sensitivity curves covering different ranges of wave-lengths, so that the whole of the spectrum from 350 to 1,000 mμ could be measured. At the shorter wave-lengths stray light was reduced to the 1 per cent. limit by the use of a Chance OX7 filter. The bandwidth was not more than 10 mμ anywhere and in the 350 to 600 mμ region it was less than 3 mμ. A sliding carriage accommodating four absorption cells allowed for the rapid intercomparison of up to four samples.

A very interesting exhibit was Prof. W. D. Wright's photo-electric spectrophotometer and tristimulus colorimeter for transmission and reflection measurements in the visible spectrum. This instrument consists of a large double monochromator producing a 10-in. spectrum and is designed on the same basic principle as the Wright trichromatic colorimeter, except that a mirror strip instead of a roof prism is used to select the waveband in the spectrum and reflect it back through the dispersing prisms. The bandwidth is determined by the width of mirror used, and several sizes of mirror are available, providing from fine to very coarse resolution of spectral absorption bands.

The colour filter or surface whose spectral transmission or reflection curve is to be measured is illuminated by the light emerging from the exit-slit of the monochromator and provision is made for varying the angle of incidence of light on the specimen and the direction in which the light is picked up by a G.E.C. Universal Precision Photo-electric Photometer Unit. This is a great advantage in practical work because, although the angles of incidence and of viewing to be used in the colorimetry of reflecting surfaces have been laid down by the C.I.E., these conditions are often varied, sometimes for very good reasons.

The instrument is non-recording and was designed for teaching and research. It can be adapted for use as a tristimulus colorimeter by mounting a 10-in.-long strip of concave mirror in the plane of the spectrum to reflect and reunite the whole of the spectrum on its return passage through the dispersing system. Templates can then be placed in front of the mirror, of such a shape that, in conjunction with the spectral sensitivity of the photocell, the whole system has a sensitivity corresponding to the x, y or z distribution curve of the C.I.E. system of colour measurement.

Stereoscopic Vision

Professor Wright also showed a number of pieces of apparatus connected with the study of stereoscopic vision. One of these was used for investigating the extent of the contribution made by the convergence of the eyes to stereoscopic acuity. Another demonstrated that fusion of the images seen by the two eyes was not an essential element in three-dimensional seeing. A third piece of apparatus shown was used to study the design of binocular eyepieces and to determine the conditions which gave maximum comfort in binocular viewing systems and maximum precision of setting in contour plotting from stereoscopic photographs.

In a nearby dark-room Dr. Wright projected some very beautiful still colour pictures which were seen in three dimensions when viewed through polarising spectacles.

Lamps

Of considerable interest to those concerned with photometry was the "constant light source" exhibited by Casella (Electronics) Ltd. To ensure constancy of luminous intensity without the use of a battery, especially in the case of a low voltage, high wattage, lamp is not easy, particularly when only a D.C. supply is available. The apparatus demonstrated was stated to control the light output to within 1 per cent. for changes of mains voltage of as much as 10 per cent. A photocell was exposed to the light from the lamp, and the photocurrent, after amplification, was fed back to the oscillator controlling the input

to the lamp. In this way the effects of both mains voltage variations and variations taking place within the lamp itself could be kept within the limits stated.

Other exhibits concerned with light sources were shown by the B.T.H. Research Laboratory. One of these demonstrated improvements in the colour-rendering properties of high-pressure and low-pressure mercury vapour lamps by the use of new phosphors. Another showed improvements in flash tube design which have made possible the production of lower voltage lamps for signal flash operation with a high overall efficiency when operated from electrolytic capacitors.

Closely connected with lamp development was the series of demonstrations arranged by the Siemens Research Laboratories to show phenomena of general scientific interest encountered during the course of work on electric discharges through rare gases and vapours. One of them was a striking example of the effect of convection currents on a horizontal arc when the arc length is great in comparison with the diameter. Another demonstration was of the cyclic changes of brightness of the electrodes of an arc on alternating current. These could be clearly seen when the arc was viewed through a synchronised shutter. Then there was an interesting demonstration of the effect of wall temperature on the colour of the light emitted by an arc passing through a mixture of a rare gas with a metallic vapour such as mercury or sodium. Perhaps the scientifically most interesting demonstration was that of the effect of current density and wattage loading on the spectral distribution of the radiation from an arc discharge. The light given by a continuous arc in Xenon was compared with that emitted when the same tube was operated so as to give a flash discharge.

Filters and Conducting Films

Interference filters which were much in evidence last year seem to have suffered an eclipse, but Messrs. Barr and Stroud, Ltd., were showing some "all-dielectric" filters depending on the use of the multi-layer technique, the development of which seems to show much promise.

Transparent conducting films on glass have now clearly taken on considerable importance. Megatron, Ltd., were showing three different kinds and a number of instrument windows coated in this way to obtain electrostatic shielding. Then in the N.P.L. exhibit the Light Division was showing the film developed to enable aircraft windows to be kept free of condensed moisture and ice by electrical heating of the window itself. A power input of about 1 kw. per square foot of window is required. The film is formed by first depositing a layer of bismuth oxide about 100 Ang. thick, followed by pure gold about 70 Ang. thick. The coated sheet is heated to 220—250 deg. C. for a short time. The oxide substrate affects the superposed gold so as to ensure reproducible and low electrical resistance, high optical transmission and unobtrusive colour. Addition of a similar layer of the oxide on top of the gold, with heat treatment, gives a further improvement in these properties and some mechanical protection to the gold film. The final product has a resistance of less than 10 ohms between opposite edges of a square sample and the transmission for white light is 75 per cent.

Microphotometer

Messrs. Hilger and Watts, Ltd. (Hilger Division), were showing a relatively simple type of recording microphotometer, modified from a Hilger Non-Recording Microphotometer. The instrument is seen in the accompanying figure. The photo-voltaic cell of the non-recording instrument is replaced by a special mount containing a photomultiplier cell connected, by way of a unit containing a power supply and an amplifier, to a quick-acting pen recorder. The ordinary slow motion of the microphotometer, when fitted with a synchronous electric motor, has a scanning distance of two centimetres which can be used anywhere in the length of the plate and this is sufficient if only small spectral ranges are to be recorded, but an alternative model is fitted with a motor-driven screw motion with a scanning distance of about six inches. The power supply and amplifier are entirely mains operated and contained in a metal cabinet which can be placed in any convenient position near to the microphotometer.

The Five Ps

The discourses this year were of no special interest to the lighting engineer, but Dr. L. A. Jordan's lecture, entitled "Particles. Pellicles; Pigments, Paints and Physics," was a very interesting account of work at the Paint Research Laboratory (of which Dr. Jordan is Director) on the physical factors which affect the properties and behaviour of paint films. His discourse was illustrated with a film on pigment flotation in paints.

Lighting on New French Liners

The Flandre

The Compagnie Generale Transatlantique has recently put into service two new additions to its fleet, the *Flandre* (20,500 tons) and her sister ship the *Antilles* (20,464 tons). The *Flandre* is intended for the New York route and the *Antilles* for the service to the West Indies. The former has first and cabin-class accommodation and carries 781 passengers; the latter has in addition a tourist class, with total accommodation for 777 passengers.

In both ships use is made of the latest lighting techniques, and skill has been shown by the interior designers in using modern light sources. Hot cathode fluorescent lamps are used in both boats, the lighting of the *Antilles* being entirely by this means. The decision to use fluorescent lighting was based on experience already gained with other ships. The advantages of fluorescent lighting as regards greater light output per unit of energy and the lower operating temperatures are well known, but are of particular importance where the lighting of ships is concerned. Each new ship installation has confirmed these advantages. In addition it has been found that fluorescent lamps and their fittings stand up very well to the vibration of the vessel and to the corrosive sea air, thereby making the problem of maintenance, never an easy one on board ship, a little less difficult. Ships' architects and designers have now had some experience in the use of fluorescent lamps, and are learning how to use them to the best advantage.

The layout of the two ships is the same, though the interior decorations and the lighting differ. Some illustrations of the *Flandre* are given, but the following description refers only to the *Antilles*.

The lamps used on the *Antilles* are similar to those in use on the *Liberté*, where they have given satisfactory service for some time and where an average life of over 8,000 hours has been obtained. The lamps are of the instant-start type in two sizes, 60-cm. and 120-cm.; they were made by Claude, Paz and Silva, of Paris. A few 47-cm. lamps are also used. The 60-cm. lamps have a light output of 1,100 lumens for 31 w., and the 120-cm. lamps have an output of 2,200

First-class lounge of the Antilles (above) and of the Flandre (right). In construction these rooms are identical but have been treated in different ways; the centre part of the room on the Antilles has been given a barrel ceiling and the lighting treatment is different.

Cabin-class dining-room on the Flandre. Note difference in lighting between this space and the similar space on the Antilles shown opposite.

lumens for 53.5 w. Individual power factor correction is not used in order to avoid the use of a large number of small and fragile condensers.

When the lighting was first under discussion it was thought that a mixture of tungsten and fluorescent lamps would produce the best results, giving a warm light similar to that of the tropics in which the ship was to be used. Extensive tests were made to get the desired results, including the effect of the colour obtained from different mixtures on such things as the hair of young ladies, on clothes and on food. It was

First-class dining-room on the Antilles showing glazed ceiling.

Cabin-class dining-room on the Antilles. The space is similar to that in the sister ship, but the lighting treatment is different.

found that a colour with a predominance in the yellow-orange (similar to candle-light or the colour given by the old-fashioned lustres) was the most satisfactory. This colour, however, was obtained without the use of tungsten lamps. It was given the name "Cocktail"—which may help to make it more acceptable than the names usually given to new colours in the fluorescent lamp range.

The interior designers then chose the colours of their furnishings in relation to this colour with very pleasing results. In some places the lamps and fittings have been arranged in neat, clean lines, and in others, such as in the lounges and dining-rooms, they have been incorporated into the architectural features.

Glass in a wide variety of finishes and shapes has been used as the diffusing material for the ceiling and wall fittings, and solid bronze mountings to harmonise with the decorations have been specially designed. Here again the question of ease of maintenance was given careful consideration. Fittings of these types are used in the embarkation hall, stairs, corridors, the cabin-class lounge and dining-room, and also on the sides of the first-class dining-room, lounge and smoke-room. The centre part of the latter rise to a height of two decks. In the first-class dining-room and the first-class smoke-room the ceiling of this centre part is completely glazed, concealing a large number of fluorescent lamps. The centre of the first-class lounge has a barrel ceiling indirectly lighted by two rows of lamps concealed in the cornices on either side. The resulting uniformity of the ceiling is relieved by tungsten lamps in star-shaped fittings let into the ceiling.

A total of 1,100 fluorescent lamps is used on the *Antilles*, 500 of the 60-cm. size and 600 of the larger size. The loading is between 25-30 watts per square metre (approx. 2.5-3 watts per sq. ft.), including decorative effects such as curtain lighting and lighting in various bars.

The illumination levels obtained are:—

Dining-rooms	10-20 lm./ft.^{2}
First-class lounge	
Under domed ceiling ...	12 „
Sides	8 „
First-class smoke-room	
In the centre	13 „
Sides	9 „
Reception halls	15 „
Corridors and passages.....	10 „

These two ships, being identical in construction in almost every respect, provide an interesting example of different treatment of similar spaces both as regards interior decoration and lighting. Examples of this are shown in the illustrations.

Lighting for Aircraft Maintenance

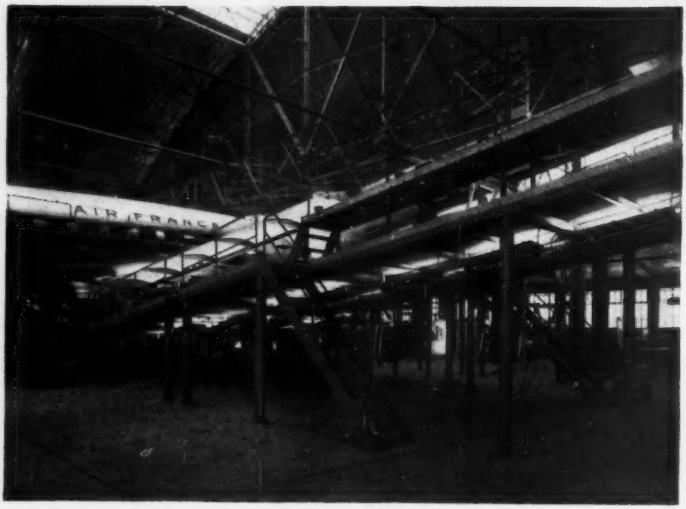
The maintenance of large aeroplanes presents some particularly complex problems. Besides the usual overhaul carried out at every flight, the aircraft is regularly submitted to a thorough inspection, the intervals of these inspections being varied according to the number of flying hours and the lines on which it travels (cold or tropical regions).

The lighting of a workshop, when it is by ceiling fittings, makes certain repairs on a plane difficult, especially when they concern the underside of the wings. It has often been necessary to resort to the use of hanging lamps, but this form of local lighting is unsatisfactory because of the low light output of the lamps and the glare produced.

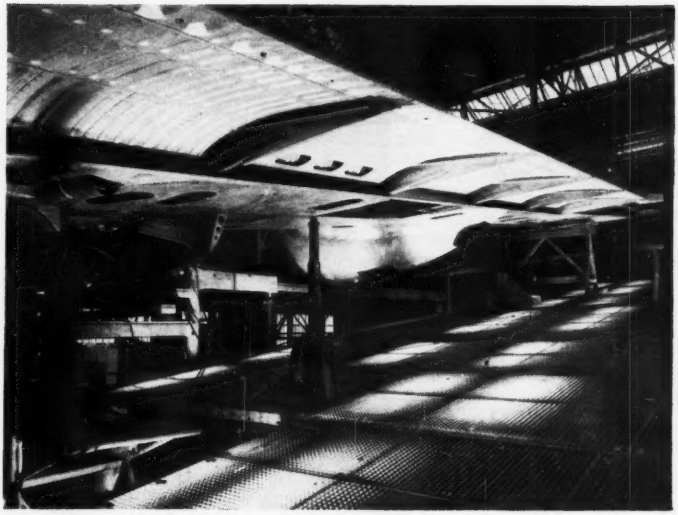
Air France has just completed in the hangars reserved for large overhauls at Orly airport a lighting installation which is noteworthy because of its originality. The aim of the lighting was to place the fittings in such a fashion as to avoid glare.

A permanent staging has been constructed

(*Above*) *Showing the positions of the fittings.*



(*Left*) *View of one of the hangars at Orly Airport.*



View of the staging which is built to fit the aircraft. The fittings are placed under the trellis work.

to fit around the aircraft, the present installation being for the Air France DC6. The staging is of metal trellis work which can take heavy loads. The lighting fittings are attached underneath this structure, the trellis work of which acts as a diffuser to the lamps, thus reducing the risk of glare. An illumination of about 12 lm./ft.^{2} is provided on the underside of the wing. Industrial reflectors housing two 40-watt white fluorescent lamps are used and are placed to give lighting where it is required rather than to give an even general illumination. The installation is the only one of its kind in Europe. The above details and photographs were supplied by M. Jean Despres, of the Compagnie des Lampes, Paris.

SITUATIONS VACANT

Crompton Parkinson, Limited, invite applications in connection with vacancies in their Overseas Sales Division. Positions are:—FIELD SUPERVISOR — PLANT PRODUCTS. Applicants for this post should have extensive commercial experience (preferably in overseas territories) involving sales of rotating electrical machines, switchgear, transformers, and instruments. FIELD SUPERVISOR — LIGHTING EQUIPMENT AND CABLES. For this post applicants should have first-class and wide experience in sales of electric lighting equipment and cables, and should be expert in lighting engineering (including street lighting). Successful applicants will operate from headquarters in London and will be willing to travel overseas for about six months in each year (although trips abroad may not extend beyond three months).—Applications, stating age and giving details of education, technical qualifications, experience and other relevant matters should be addressed to JHF/P, Crompton House, Aldwych, London, W.C.2.

SALES MANAGER required by prominent Manufacturing Company in the Lighting industry. The position involves control of sales force in London and Provinces, and requires considerable knowledge of sales techniques and experience in selling in a highly competitive field. — Applications, giving full details of past career, should be sent in confidence to Box A579, c.o. Central News, 17, Moorgate, E.C.2.

TECHNICAL ASSISTANT (LIGHTING) required at London Headquarters. Capable of preparing schemes and estimates for gas and electric lighting for all classes of railway premises. Commencing salary £714 15s. per annum.—Apply Civil Engineer, Southern Region, British Railways, Waterloo Station, S.E.1, giving details of experience and academic qualifications.

Lighting Fittings DESIGNER, with experience in the preparation of manufacturing drawings, required.—Replies, stating age, experience and salary required, to the Manager, Troughton and Young (Lighting) Ltd., 143, Knightsbridge, S.W.1.

New Lighting Installations

Boots' Swansea Branch

It is noticeable how many new buildings are springing up on the old bomb-sites of our towns and cities. One of the firms which is making an important contribution in this respect with its own rebuilding programme is Messrs. Boots Pure Drug Co. A particularly fine example is the new branch at Swansea, which is now complete and occupies a prominent corner site in the new shopping centre of the town. This imposing four-storey building is built in sand-faced, heather-coloured brick-work, with reconstructed stone facings under a canopy at first-floor level.

Under the direction of Mr. C. St. Clair Oakes, M.B.E., F.R.I.B.A., chief architect to Messrs. Boots, who was responsible for the design of the building, the lighting, which was planned in collaboration with The General Electric Co., Ltd., has formed an integral part of a planned scheme of achitectural design and decoration.

Both the ground and first floors are devoted mainly to sales areas including a library, book department and a large dispensary. The ceiling of the ground floor is broken up by 12 lemon-white plaster coves 7 ft. in diameter from the centre of which is suspended a specially designed pendant comprising a heavy cast amber-tinted glass bowl housing 10 200-watt silverlight lamps. The edge of the bowl lines up with the bottom edge of the cove, 11 ft. above floor level, producing a very pleasing effect on the purple-stippled ceiling. The illumination of this area is about 30 lm./ft.^{2}.

To facilitate efficient service, attention

has been focused on the counters by high intensity lighting at effective points. Eighty Gecoray reflectors are recessed into the false ceiling, spaced 4 ft. apart and equipped with 200-watt pearl lamps. Special louvres fitted into the recesses cut off the direct view of the lamp and eliminate glare.

Immediately behind the counters an egg-crate louvre ceiling is hung 8 ft. 6 in. above floor level. Mounted 2 ft. 6 in. above the louvres are triple rows of cold cathode tubes comprising 470 ft. of "warm-white" tubing in two outer rows and 235 ft. "gold" tubing in the centre. The result of this combination of tungsten high intensity spot-lighting and cold cathode medium intensity diffused lighting is to provide a warm, attractive soft illumination of the order of 75 lm./ft.^{2}, producing excellent colour rendering on goods, whilst at the same time being pleasantly flattering to shoppers.

Lining the walls behind the counters are glass-fronted wall display cases stocked with a variety of toilet requisites. Each of these 5-ft.-long cases is illuminated by five reflectors fitted with 60-watt lamps concealed in the top of the case; a total of 260 lighting units are employed.

On the first floor the ceiling of the sales area is attractively decorated in grey-green emulsion stippled paint, whilst the library section is in warm pink. Here some 33 special ceiling fittings, incorporating 30-in. diameter opal "Perspex" bowls are located in diagonal formation to form a "domino" pattern. Each fitting is equipped with four 100-watt pearl lamps to provide a soft, glare-free illumination of 25 lm./ft.^{2}.

Outside, the 11 windows, which vary in length from 4 ft. to 20 ft. and front two streets, are dramatically lighted by a combination of twin-tube fluorescent ceiling units with "natural" tubes, and prismatic-glass reflectors with tungsten lamps. All the lighting units are concealed behind egg-crate louvre ceilings.

The modern lines of the corner façade of the building are emphasised at night by sodium floodlighting.

Mr. Frank Walker, F.I.E.S., Chief Electrical Engineer, Architects Dept. of Boots, was responsible for all electrical layout; the installation work was carried out by Messrs. Hartley Electromotives, Ltd.

Subways at London Airport

An interesting cold cathode lighting installation in the vehicle subways at London Airport has recently been completed. The subways are the first of four, each about 500 ft. long with carriage-way and foot-paths, connecting the central control and administrative area with the perimeter. The subways are 25ft. wide and 12ft. 6in. high.

The installation in the two tunnels comprises 150 fittings each 10ft. long and fitted with either two or four standard 9ft. 6in. cold cathode tubes. The transformers are housed at either end of the fittings, and the glazed doors giving access to the interior are fitted with interlocks which break the primary circuit when the doors are opened.

The fittings, which were designed by the

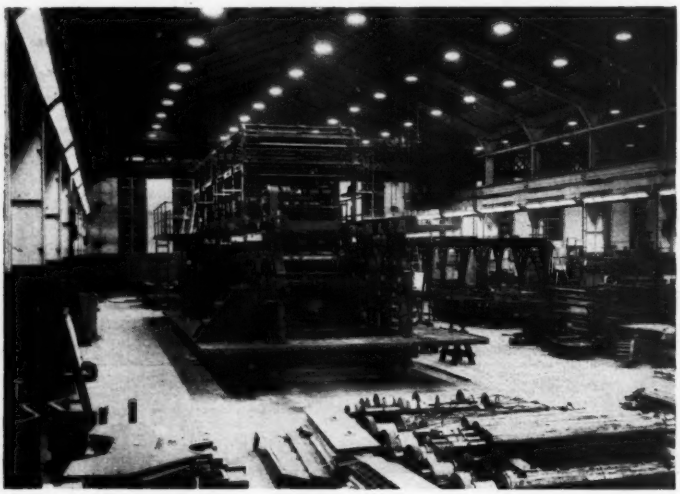
The ground floor of the Swansea branch of Messrs. Boots Pure Drug Co.

Courtney Pope fittings, each 10 ft. long, containing either two or four 9 ft. 6 in. cold cathode tubes, illuminate the first two vehicular tunnels at London Airport.

Air Ministry and built to their specification, fit into the top corners of the tunnels, and cover strips are provided so that the fittings present one continuous face. The fittings may be switched for "day" or "night" operation, the daylight position giving a higher level of illumination; the intensity of light at the ends of the tunnels during the hours of daylight, is higher than in the centre.

An intensity of 25 lm./ft.^{2} is obtained at road level, and drivers are not seriously inconvenienced when entering the tunnels from daylight.

The fittings were manufactured and installed by Courtney, Pope (Electrical) Ltd.



Benjamin reflectors and side lighting by fluorescent lamps illuminate this erection bay in a printing works.

Night - time view of the interior of a textile factory in Worksop.

An Erection Bay

The lower photograph on the previous page shows one of the new bays in the Water Lane Works of R. W. Crabtree, Ltd., Leeds, where printing presses are erected and where a Hoe-Crabtree press is seen in the course of erection. The arched structure on the right constitutes the lower deck and when the press is finally installed in a newspaper printing establishment, the portion shown on the left surmounts the arches.

A very high degree of precision is necessary in this work and, as will be noticed, the machine itself causes considerable light obstruction to the parts lying within it.

Consequently, well diffused general illumination is required in the working zone, which may extend to all heights up to 20ft. above floor level. This is provided by a relatively closely spaced overhead installation of Benjamin R.L.M. reflectors, in conjunction with almost continuous side lighting by means of 80-watt fluorescent fittings mounted at a height of 16ft. above the floor. This treatment gives good illumination on vertical faces and light penetration into the large and intricate assemblies.

The 750-watt reflectors are finished in "Crysteel" vitreous enamel and fitted with "Visor" covers to prevent dust and obviate the need for frequent cleaning. They are on approximately 15ft. 6in. x 15ft. 6in. centres mounted 31ft. above floor level.

A very interesting feature noticed was that before the installation was completed, the uprising air-currents from the heating system caused the suspended R.L.M.'s to swing. The fitting of the dustproof "Visor" covers, on completion, however, streamlined the R.L.M.'s so that they remain steady and, of course, prevent the dust carried upwards by the rising air from settling on the lamp and reflecting surfaces.

Bairns-Wear Factory

One of the essential requirements of the mill building at the new Bairns-Wear factory at Worksop was that it should be well lit and kept as free of obstruction and dust as possible. The building has, therefore, been designed with monitor roofs with glazing running north to south so as to give good daylighting conditions.

The artificial lighting is provided by three rows of fluorescent fittings mounted on the ceiling. The fittings are of the vitreous enamelled slotted type made by F. W. Thorpe, Ltd., and each carries one 90-watt warm-white fluorescent lamp. The fittings are wired in threes in each structural bay.

Correspondence

Lighting in Hazardous Atmospheres

To the Editor, LIGHT AND LIGHTING.

Dear Sir,—I would refer to an article published in your March issue entitled "Lighting in Hazardous Atmospheres," where, on page 100, reference is made to the possibility of sparks being struck upon aluminium finishes. I think sufficient stress has not been placed upon the entirely unusual conditions necessary to accomplish this feat.

An authoritative article entitled "The Ignition of Inflammable Gases by Sparks from Aluminium Paint and Rusty Steel" was published in the *Journal of Applied Chemistry* dated August 2, 1952.

There is a summary at the head of the article which shows how exceptional, if not impossible, the conditions have to be to give rise to the alleged phenomena.

The evidence in the publication shows that the use of oil-bound paint reduces the risk to vanishing point. Most normal apparatus is certainly not operated at a temperature of 150 deg. C., and even lighting fittings are limited to a maximum of 80 deg. C.—Yours faithfully

J. J. HUNT.

Oldbury, Birmingham.

Illumination Trends

To the Editor, LIGHT AND LIGHTING.

Dear Sir,—I read with interest Mr. Horniblow's letter in the March issue of "Light and Lighting" Whilst I agree with much of what he says, it does raise a very serious question.

I am an average lighting engineer employed by a fairly well-known electrical firm. My work consists of visiting my firm's clients and endeavouring to get out a lighting scheme which will be acceptable to them, and which will eventually involve the use of my firm's fittings, etc.

If I achieve this my principals are reasonably satisfied with the business I have obtained. In other words, by adhering to a rule of thumb method, I have succeeded in obtaining an order for a lighting design, the necessary fittings and parts of which are, naturally, supplied by my employers.

Were I a free-lance lighting engineer I would, when visiting a client, "prescribe" the type of light required by my client and not merely tell him just how many lumens he wants based on a rule of thumb principle. I might suggest a new floor covering; differently painted ceilings and walls; alteration of the positions of fixtures and furniture. I might even talk to the people who are going to work under my scheme, in an endeavour to ascertain the type of sight they have, and the type of work they are going to do, so that eventually the light they would work in would suit them physically, mentally, psychologically, and aesthetically.

I say I would do all this were I a free-lance lighting engineer, but were I to attempt this under the present conditions of my employment as a lighting engineer it would not be very long before my employers were looking for another "rule of the thumb" man.—Yours, etc.,

Birmingham. WM. HEMINGWAY.

Lighting Terms

To the Editor, LIGHT AND LIGHTING.

Dear Sir,—I see from your April issue that Mr. Robinson's predilection for the foot-candle is unabated. Will you allow me in your columns to ask him a question? If the metric system were adopted in this country, would he object to "lux" and clamour for the return of the long-since-abandoned "metre-candle"? As for the suggestion that the layman finds "foot-candles" easier to understand than "lumens per square foot," I have yet to meet one who does! No, sir; "foot-candle" is not merely unclear to the layman, it is positively misleading. He knows what a candle is, and the first idea that "foot-candle" conjures up is certainly not the one we want the layman to have. Much as I dislike the term "foot-lambert," it does not mislead the layman, but simply defeats him; he has no idea of a "lambert" and so cannot visualise an elongated one. Mr. Robinson argues that "foot-candle" is no more than a convenient name for a unit. I agree with him, subject to deletion of the word "convenient"! Much more convenient (though not yet for us) is "lux"; but why not settle for "luma"? This is a nice short euphonious word signifying *lum*en per unit *a*rea, where unit area equals the square foot.—Yours faithfully,

"DIMMERWIT."

London.

Electrical Engineers' Exhibition

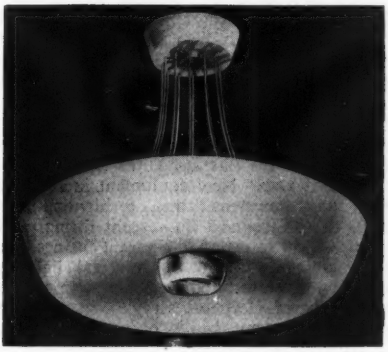
A brief report on the lighting exhibits at the recent A.S.E.E. exhibition at Earls Court.

The second Electrical Engineers' Exhibition organised by the Association of Supervising Electrical Engineers was held at Earls Court from March 25 to 28. The first exhibition held last year proved a great success and larger premises had to be found for the increased number of exhibitors. The main feature of the exhibition was the 'Illumination Way," which extended through the length of the hall and along which was suspended a wide range of lighting fittings. Other fittings were exhibited on the individual stands.

The centrepiece of the THORN ELECTRICAL INDUSTRIES' stand was an ingenious machine devised by the company's engineers for the testing of glow switch starters for fluorescent lighting. This machine, which was seen in operation, takes each glow switch starter and subjects it to many hundreds of starts, after which its operation on minimum supply voltages and against maximum tube voltage is tested. The results of these tests are summarised in a special memory circuit which passes or rejects the glow switch as it leaves the machine. Up to 72 glow switches at a time are under test.

The new floodlights shown by THE BENJAMIN ELECTRIC, LTD., included the enclosed area floodlight expressly designed to meet the demand for a dustproof fitting suitable for pole or wall mounting. It is therefore supplied with two " U " bolts for 2-inch outside diameter pole; these can be dispensed with if it is desired to mount direct on a flat surface. The new design fixing aluminium alloy bracket can be reversed in the attachment to the neck to provide for horizontal or vertical poles or surfaces.

Another new Benjamin model known as the " Treelite " was on show. This exclusively-designed reflector to meet the need for better festive lighting is specially suitable for tree and bush lighting. It provides all-round illumination while upward light apertures give a most pleasing effect in the foliage. It is suitable for B.C. lampholders and lamps up to 150 watts.



Siemen's decorative fitting for circular fluorescent lamps.

SIEMENS ELECTRIC LAMPS AND SUPPLIES, LTD., stand featured chrysaline illuminated devices as well as floodlights and other decorative features, providing a wide range of choice for all interested in the preparation of schemes for the forthcoming celebrations. In addition to the fluorescent fittings shown in Illumination Way, some new fittings were displayed on the stand, two outstanding ones being those for the circular fluorescent lamp.

PHILIPS ELECTRICAL, LTD., showed, for the first time in this country, the " Rotterdam Ceiling " development in store lighting. It consists of an aluminium faced grid of

squares of approximately 24-inch sides, placed 2 ft. below the ceiling proper, which is painted matt black. Louvres are dropped into pairs of squares which are to be lit, and a trough fitting carrying two 4 ft. instant start lamps with the two appropriate tungsten ballast lamps is placed above. To move the lighting, it is only necessary to slide the fitting to its new position and transfer the louvres. Special display features are picked out by means of spotlight reflector lamps mounted above the grill.

The wide range of internally mirrored lamps developed by Philips for display, floodlighting, photographic and industrial heating supplies is also shown. Selling at £4 15s. complete with 500-watt internally mirrored lamp, the "Weybridge" floodlight is an interesting addition to the well-known range.

Lighting and power exhibits were seen on the stand of the BRITISH THOMSON-HOUSTON COMPANY, LTD. New equipment included a high bay tungsten fitting, a blended-light unit, the "Circline" fluorescent fitting, and the FX1,250 series of fluorescent fittings. A 9 ft. run of "Mazda" Universal lighting trunking demonstrated the ease with which a number of electrical services, in addition to lighting, may be incorporated in one installation.

Lighting in industry, commerce and public service was the theme of the HOLOPHANE STAND. An extensive range of lighting units was shown, including the new "Lumilux" commercial unit, an industrial glass-canopy unit which is entirely translucent, flameproof lighting units for hazardous areas in oil refineries and chemical works, industrial translucent units for use where there is a high content of vapour and dust in the atmosphere, bulkhead fittings, and a number of pendant and close-ceiling units for commercial interiors.

Benjamin enclosed area dust-proof fitting.

Holophane flameproof industrial lighting fitting housing up to 200 watts.

The EDISON SWAN ELECTRIC CO., LTD., showed lighting equipment, cables, and electrical accessories. A number of street lighting lanterns were on show, including the B.T.20, a simple, easily maintained open dome refractor lantern for minor road lighting, and the STA/1, a totally enclosed plate refractor lantern for group "A" road lighting, using 85-watt or 140-watt sodium discharge lamps. Cold cathode lighting reflectors were also shown.

VENNER, LTD., showed time switches, process timers, and automatic switching devices covering municipal, commercial and aeronautical application, together with a large range of alternative clocks which can be used as prime movers.

REVO ELECTRIC CO., LTD., showed a number of their floodlights and street lighting lanterns. Other firms exhibiting lighting equipment included: J. A. Crabtree and Co., Ltd.; Crompton Parkinson, Ltd.; Dorman and Smith, Ltd.; E.L.M.A.; Falk, Stadelmann and Co., Ltd.; G.E.C., Ltd.; Ionlite, Ltd.; Londex, Ltd.; Simplex Electric, Ltd.; Strand Electric and Engineering Co., Ltd.; Troughton and Young, Ltd.; Walsall Conduits, Ltd.

I.E.S. ACTIVITIES

Coronation Year Dinner

The Coronation Year Dinner in London will be held at the Café Royal on Wednesday, May 13. Details have been circulated to members and, as this is a special year, it is hoped that many will be present. Those wishing to apply for tickets should communicate with the secretary at 32, Victoria-street, London, S.W.1.

London

The sessional meeting in London on March 10 took the form of a discussion on Post-War Building Study No. 30, the report on the Lighting of Office Buildings. The discussion was opened by Mr. P. V. Burnett, who was chairman of the committee responsible for the report.

Mr. Burnett said that the report is the most comprehensive report on the subject of office lighting that has been published in this country because, for one reason or another, office buildings have been nobody's baby. Although there are large numbers of office workers, there have not been any regulations governing the lighting of offices. The study of the lighting requirements of offices therefore had to begin from scratch; a large volume of evidence, much of it quite new, was collected and considered before the report was completed.

The development of office buildings in this country has proceeded since the nineteenth century step by step with the growth of our foreign trade. In more recent years the growth in the number and size of Government departments has been an important influence. At first the design of office buildings followed contemporary fashions, but later more attention was given to functional needs, including natural lighting, though little attention was given to artificial lighting.

In more recent times the development of forms of artificial lighting that merge easily with daylight has had the effect of causing office blocks to be planned that are deeper than could be lighting by daylight alone. This tendency increased until office blocks without any daylight and depending entirely on artificial lighting were contemplated; this tendency would, however, now seem to have been reversed as modern office blocks in America and elsewhere have the largest possible window areas.

In this country at present the evidence before the committee was that 37 per cent. of office workers questioned complained about the daylighting of their offices and 41 per cent. complained about the artificial lighting.

Mr. Burnett then went on to deal with the report and the recommendations of the committee in detail.

A number of comments on the report and the recommendations were made in the course of the discussion; those taking part included Mr. J. G. Holmes, Dr. H. H. Ballin, Dr. Ferguson, Mr. A. H. Young, Mr. W. Allen, Mr. A. G. Penny, Mr. R. O. Ackerley, Mr. F. C. Smith, Mr. A. Cunnington, and Mr. Imrie Smith.

Glasgow Centre

The annual dinner of the Glasgow Centre was held on March 3, and, for the second year in succession, ladies were present and it was gratifying to note the large attendance of members and friends.

Mr. C. J. King, the Centre chairman, in proposing the toast, "The Illuminating Engineering Society," stressed the need for members to view their activities as a cultural society closely allied to trade and engineering industry. The president, Dr. Wellwood Ferguson, in replying to the toast, urged present members to widen the scope of the Society by encouraging the entry of new members from all the industries and professions in close contact with the lighting industry.

The toast of "The Guests" was proposed by Mr. D .McDougall in a very amusing and witty speech. The response to this toast was made by the secretary, Mr. G. F. Cole.

The committee welcomed amongst the guests Dr. A. Mellick, the Glasgow ophthalmologist who delivered a paper to the Society earlier in the year, and Mrs. Mellick.

Edinburgh Centre

The Edinburgh Centre have held an annual dinner for a number of years and

this year decided to hold a dinner-dance, which was held on March 4 and was attended by the president, Dr. Ferguson, and Mrs. Ferguson, and the secretary, Mr. G. F. Cole. Dr. H. Buckley, chairman of the Centre, welcomed the guests in a short speech to which Dr. Ferguson replied. The dancing, which was as successful as the dinner, continued into the small hours of the morning, the programme including all the energetic dances for which the Scots are well known.

Newcastle Centre

The annual dinner-dance of the Newcastle Centre was held on March 6, when a large number of members and their ladies had a most enjoyable evening. In the brief speeches after the dinner the Centre chairman, Mr. G. Kingsley Lark, welcomed the guests and Mr. C. A. Harding, president of the Northern Architectural Association, replied. The toast of the Society was proposed by Mr. H. F. Leyburn, chairman of the Newcastle Centre of the I.E.S., and replied to by Dr. W. J. Wellwood Ferguson, president of the Society.

Leeds Centre

The proceedings at the February sessional meeting included a lecture by Mr. W. L. J. Potts, Lecturer on Mining at the University of Leeds, a member of the Centre. The lecture, "Lighting in Mines," was given to a large gathering. Engineers and officials from Nos. 7 and 8 Areas of the North-Eastern Division, National Coal Board, were among guests present.

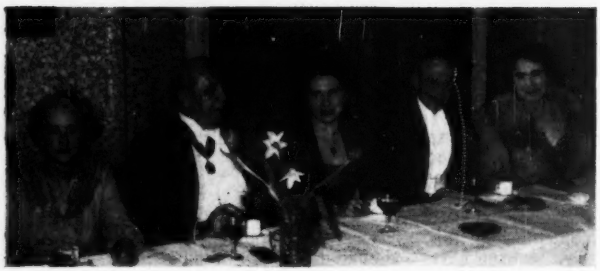
Mr. Potts gave a review of the lighting of collieries from the days of the earliest mine workings, leading up to the present standards of lighting and the methods of achievement. The meeting was followed by a discussion, after which members were given an opportunity of inspecting the comprehensive display of equipment exhibited by Mr. Potts.

Liverpool Centre

On February 24 Dr. B. P. Dudding lectured to the Liverpool Centre on the development of the tungsten lamp. Dr. Dudding first became interested in incandescent electric lamps when he joined the staff of the National Physical Laboratory in February, 1911, as assistant to the late Sir Clifford Paterson. Among his duties at that time were assisting in the establishment of an international standard of candle-power and the commercial testing of electric incandescent filament lamps. He became closely associated with the lamp industry in January, 1919, and since that time has been engaged on research and development of filament lamps as a member of a research organisation.

In his lecture he called attention to the conditions prevailing in 1904 when the first tungsten lamps became commercially available, and indicated the influence which the performance of carbon filament lamps and that of the incandescent gas mantle had on the early development of the tungsten filament lamp. The lecture was illustrated by slides and by a few simple demonstrations.

Dr. Dudding described the gradual development which has characterised the four industries with the manufacture of lamps. These industries are glass manufacture of bulbs and tubing; the metallurgical industries for the production of tungsten, molybdenum, and other special alloys used in the industry, and its off-shoot the modern valve industry; the industry concerned with the extraction of nitrogen and argon from the atmosphere; and finally lamp assembly. He brought out clearly the stages in the transition from purely manual operations through periods when semi-automatic machines were in general use to the fully automatic processes which now govern production. He called attention to the fact that the lamp industry was the first in Great Britain to introduce statistical principles to inspection at all stages of these complex



At the Edinburgh Centre dinner. L. to R., Mrs. G. E. L. Comrie, Dr. Ferguson (president), Mrs. Fairweather, Dr. Buckley (chairman), and Mrs. Ferguson.

At a Sheffield Centre dinner. L. to R., Mr. E. G. R. Taylor, Dr. Ferguson (president), Mr. H. Dick (chairman), and Mr. A. Wylie.

industries in order to aid the economic development of an ever improving product. The progress achieved was aptly summarised by pointing out that in 1910 the cost of a tungsten lamp was equivalent in value to about four hours' work of a skilled mechanic, whereas to-day a more efficient article can be purchased at a cost equal to about one third of an hour's work of a skilled mechanic (neglecting purchase tax over which the manufacturer has no control).

Another very important feature of this complete revolution in manufacturing processes extending over a period of 40 years has been achieved without a serious dispute arising among those engaged in it of the kind that frequently occurs when an industry displaced handicrafts by machine operations.

Nottingham Centre

A very well-attended meeting on March 5 heard Mr. P. D. Figgis lecture on "Some Aspects of Power Station Lighting." This paper had been presented at a Sessional Meeting in London earlier in the year, and it was reported in the March issue of *Light and Lighting*. Those who were unable to attend on that occasion were very glad to have the opportunity of hearing it in the provinces and seeing the many lantern slides used to illustrate the problems involved which differ materially from those in other types of building.

The discussion was opened by Mr. W. K. Martin, chief engineer of a very large industrial firm in Nottingham, and the vote of thanks was proposed by Mr. E. G. Phillips.

Sheffield Centre

There was a large audience of members and visitors at the March Sessional Meeting when Dr. J. H. Nelson spoke on road vehicle lighting.

The speaker first dealt with headlamps both from the point of view of the main driving beam and of the meeting beam. It was stressed that the road user needs lighting to fulfil four requirements: (1) To see the direction of the road; (2) to see that the way is clear; (3) to keep his right place on the road; (4) to yield comfortable conditions and a sense of well-being. Dr. Nelson spent some time discussing, with the aid of demonstrations, the advantages of the recently introduced scheme of dipping both headlamps instead of dipping the near-side one and extinguishing the off-side one. He also dealt with the problem of dazzle.

On March 17 the Sheffield Centre arranged an informal dinner at which past and present officers and committee members were present. The I.E.S. president, Dr. W. J. Wellwood Ferguson, who is a member of the Centre, was also present. During the course of the evening the president, on behalf of the Centre, presented a dispatch-case to Mr. A. Wylie in appreciation of his services to the Centre. Mr. Wylie is retiring from the Gas Board and leaving Sheffield to live in Scotland.

Forthcoming I.E.S. Meetings

LONDON

May 12th

Annual General Meeting. Address by Mr. D. C. B. Maclurcan, A.R.I.B.A., Past-President of the I.E.S. of Australia. (At the Royal Society of Arts, John Adam Street, W.C.2.) 6 p.m.

May 13th

Coronation Year Dinner. Café Royal. 6.30 for 7 p.m.

CENTRES AND GROUPS

May 8th

NOTTINGHAM.—Spring outing to Chesterfield Glass Works.

May 12th

LIVERPOOL.—Annual General Meeting. "The Electrical Equipment of the Mersey Tunnel," by C. C. Smith. (At the Lecture Theatre of the Merseyside and North Wales Electricity Board's Service Centre, Whitechapel, Liverpool, 1.) 6 p.m.

May 15th

NOTTINGHAM.—Annual General Meeting. (At the Demonstration Theatre of the East Midlands Electricity Board, Smithy Row, Nottingham.) 6 p.m.

July 10th

NOTTINGHAM.—One-day Summer Meeting. Great Hall, Nottingham University.

POSTSCRIPT

By "Lumeritas"

Those who read the letter from Mr. A. Cunnington, published last month, will probably share his surprise that so little has been done to improve the lighting of the Chatham street in which, it will be remembered, more than 20 Sea Cadets were run down by a bus. It was certainly to be expected that no time would be lost in providing this street with really adequate lighting, for there could hardly have been a more tragically convincing demonstration of the need for it. It is to be hoped that the local authority concerned is well aware that the mere duplication of the lamps in the existing standards has not converted a bad installation into a good one, and that they mean this change to be no more than a token of intention to re-light the street properly at an early date.

There are, unfortunately, many other inadequately and even dangerously lighted streets in the country. But we are certainly not the only offenders in this matter. Within the last few months, in fact, the street-lighting in Melbourne and its suburbs has been very strongly criticised in the local Press. "Shockingly inadequate" and "an aid to crime" are two of the charges levelled against it. I remember reading in one of Emerson's essays his remark that "gas street-lighting is the best nocturnal police." No doubt he would have thought likewise about electric street-lighting had it been introduced in his time. That it would ever be used so sparingly as to be considered an aid to crime is not likely to have occurred to him.

While on the subject of bad lighting, some television productions are marred by unsuitable studio lighting. An example was the recent production of "As You Like It," in which some of the scenes seemed overcast by a haze, while the faces of the characters were at times obscured by heavy, and probably unintentional, shadows. I think, too, it is a mistake to televise scenes which—in the interest of realism—are intentionally so dark that viewers have to be forewarned of this so as to restrain them from making a futile adjustment of screen luminance.

Although there are now regulations prescribing suitable standards of lighting for schools, it may be a long while before these standards are reached in all our schools. I have previously commented on the almost unbelievably antiquated conditions of lighting in some schools, and I have recently read a newspaper report stating that in some Liverpool schools many children work in rooms with lighting arrangements regarded as bad 50 years ago—"conditions which would not be tolerated in factories for a moment." Our annual expenditure on education is vast, and our newest schools leave little to be desired in respect of lighting, but action about our "dark satanic" schools is much overdue.

In a recent issue of our oldest established journal devoted to motoring affairs, I read a rather astonishing article on yellow lighting in relation to dazzle. I say astonishing because the author holds a medical qualification, and it is editorially said that his views are of particular interest on this account, yet the article contains a number of statements about vision that are either incorrect or meaningless, as even students of illuminating engineering will know. For example, "the mechanism of scotopic vision is much more sensitive to minor variants of light intensity, and especially to reflected light"—but, in fact, brightness difference sensitivity is lower in night than in day vision. Again, "accurate focus is obtained by the fact that the cells of the retina, after receiving the impluse, do not reject it immediately, but retain it for some seconds, and the brighter the light the longer the image is retained"—this is a strange explanation of the mechanism of accommodation! Later on we are told that yellow light is "more reflective" than white light, but even in a "brown study" I cannot understand this. I can, however, guess what the author has in mind when he writes of what "is known as Physical Etherchromatic Photometry"! But I cannot imagine how "the ultra-violet groups in the blue bands (about 4,600 A.U.) manage to get into this unexpected position, and it surprises me to be told that they cause "a great stimulus and consequent loss of retinal adaptability . . ." and that "the work of Blanchard, Stiles and others has fully covered this fact, which is described as the differential threshold of light." Nor can I imagine how the "form sense" can be "the power of the eye to adapt itself to any degree of illumination." Still, one lives and learns!

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